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Development of a microSPECT system using minification

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Single photon emission computed tomography (SPECT) is a nuclear imaging technique that allows to make a functional image of the body in vivo, in contrast to the well-known radiography techniques that generate anatomical images of the body. This is achieved by injecting a substance labeled with a radioactive isotope in the body that will be directed towards certain regions in the body. The amount and regions of uptake can then give information about the presence of tumors or the functioning of certain organs in the body.

For small animal imaging, most µSPECT systems use pinhole collimators. This pinhole acts like a camera obscura by magnifying the image on the detector and thus allowing to overcome the low intrinsic resolution of the detector. Although a high resolution can be achieved using this technique, it results in a very low sensitivity and therefore long scan times are required to obtain images of sufficient quality. Besides the lack of sensitivity, these systems also have a small field of view (FOV), thus requiring translation of the animal while performing the scan. Finally, current µSPECT systems are still based on large, clinical gamma detectors thus leading to large devices that need a dedicated room and are often quite expensive.

The goal of this PhD is therefore to develop a new µSPECT system. This new system should have a better sensitivity and larger FOV than current systems and should at the same time be much smaller; it should be a benchtop system. This will be achieved by optimizing a new, more compact type of detector, the digital silicon photomultiplier, for use in SPECT applications and using a new type of collimator, the lofthole collimator, that has a square instead of a circular projection area on the detector. By combining these two items in minification mode instead of magnification mode, more pinholes can be used without overlap, increasing the sensitivity and FOV of the system and decreasing the overall dimensions of the system.